The World of Tourmaline (in brief)

Peter Rosewarne

I've borrowed the title of a new coffee table book by Gerhard Wagner for this article as it seems appropriate in that the Tourmaline Group encompasses some 14 species currently and it is found in classic localities around the world. The idea for doing this article came from a comment from Jo that EXCO had raised tourmaline as a possible discussion topic. I also have and have had quite a few tourmaline specimens in my collection over the years and have attempted to limit discussion and illustrations to those I am, and hopefully you are, mostly familiar with. I've also drawn on information in the extraLapis publication on Tourmaline, the Mineralogical Record (MR) September-October 1985 issue *Tourmaline* and taken inspiration from the MR January-February 2015 issue on the Pederneira Mine in Brazil. Photographs include photographs of photographs of world-class specimens from the *Ikons* MR supplement, *The Smale Collection* and *Masterpieces of the Mineral World*, with permission, as well as very modest specimens from my own collection, past and present.

Tourmaline specimens are associated with some of the most spectacular of mineral discoveries the world has ever seen; think blue cap tourmaline from the Tourmaline Queen Mine in the USA, the "cranberry-red" tourmalines from The Jonas Mine, Brazil and the best pockets from the Pederneira Mine, Brazil. Such specimens almost never come on the open market and are held in museums and the top private collections. Very good specimens at a more affordable cost (before the Rand went to 19 to the *Greenback*) can be had on the many reputable websites and go for about $200 to $1000, and a few tens of thousands in the case of really good specimens from classic localities.

First a bit of technical stuff: tourmaline is a boro-silicate, crystallises in the trigonal system and is mostly associated with granitic pegmatites but can also be found in metamorphic rocks. The main ions, excluding silica and oxygen, are basically sodium or calcium with a bit of lithium, iron and magnesium and sometimes chrome thrown in here and there, plus boron, fluoride and hydroxide. Crystal faces are characteristically striated along the elongated C-axis. Crystal terminations are either flat or a flattened pyramid but stubby prismatic crystals also occur. The two terminations are always of different morphology. It is pyroelectric, meaning that it develops an electric charge on being heated; the positive end of the crystal being called the antilogous pole and the negative end the analogous pole. The antilogous pole usually has the sharper more elongate pyramidal termination and the analogous a basal pinacoid. Hardness is 7–7,5.

The wide range of colours displayed by tourmaline – e.g. red, green, pink, blue, yellow – means that it is a popular gemstone, which has meant that some wonderful specimen-grade material has been cut up for gems instead of going to collectors. It also forms the centrepiece of some famous historic treasures, including a large red stone in the centre of the St Wenceslas Crown of the Czech crown jewels (see Figure 1, from extraLapis), and a chicken egg-sized red stone, previously thought to be a ruby but later identified as a Burmese tourmaline, now in the Treasure Room at the Kremlin (see Figure 2 from extraLapis).

Figure 1: St Wenceslas Crown

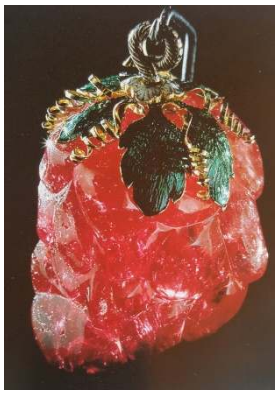


Figure 2: The Kremlin "Carbuncle"

The first tourmaline to be recognised was schorl in 1695 and the first three species listed below were the only ones recognised up to about 1962. Of the 13/14 currently recognised tourmaline species, only a few are commonly encountered and known to the mineral collecting fraternity. I'd list these as being, in order of decreasing familiarity and probably occurrence (main cation(s) in brackets):

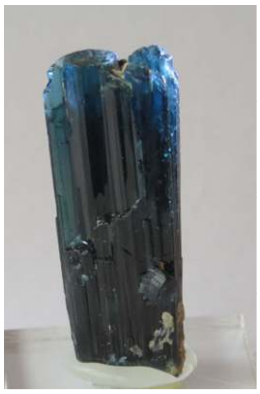
- **Schorl** ('iron tourmaline');
- **Elbaite** ('lithium tourmaline');

- **Dravite** ('sodium/magnesium tourmaline');
- Followed by, in no particular order, **Uvite** (calcium/magnesium), **Liddicoatite** (lithium) and **Buergerite**.

Elbaite is the commonest and most well-known of the coloured tourmalines although the name apparently only came into general usage after publication of Deer, Howie and Zussman's seminal work in 1962, *Rock Forming Minerals* (later condensed to *An Introduction to the Rock Forming Minerals*, published in 1966). Unsurprisingly, the type area for it is on the Island of Elba off the coast of Italy. However, the most spectacular finds have been from the USA (Tourmaline Queen, Pala and Himalaya mines), Pakistan (Gilgit, Stak Nala), Afghanistan (Paprok) and Brazil. Elbaite comes in greens, reds, pinks, blues and colourless (achroite) and is often multi-coloured along the extended C-axis. The various colour types also have popular names (non-scientific) and are broadly:

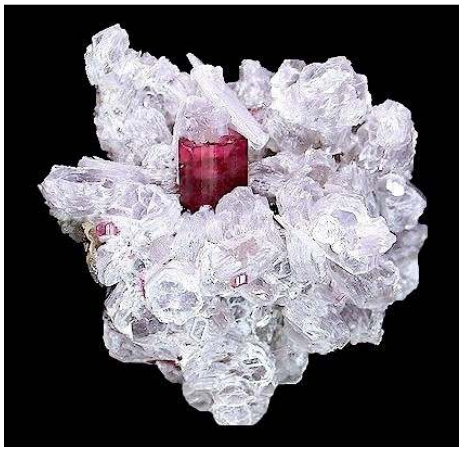
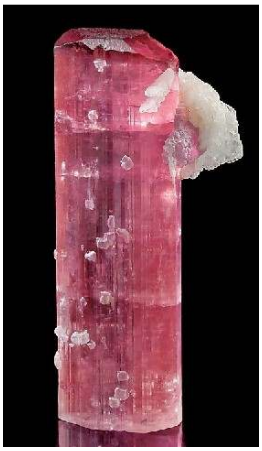
- Green - Verdelite
- Blue - Indicolite
- Pink/red - Rubellite

An example of verdelite from Brazil is shown in Figure 3 and an example of indicolite in Figure 4. A beautiful example of elbaite from Pakistan is shown in Figure 5.

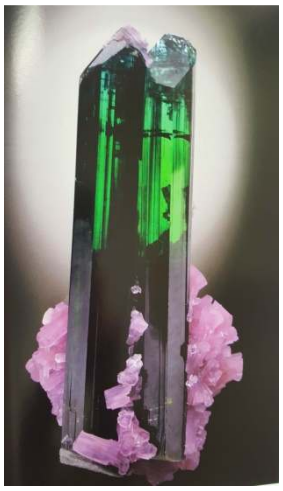

Left. Figure 3: Elbaite, var. verdelite, Brazil. Largest crystal 8,5 cm Centre. Figure 4 Elbaite var. indicolite, Afghanistan. 4 cm Right. Figure 5: Elbaite from Pakistan

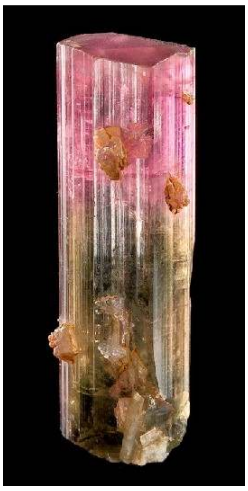
The most famous locality for world-class rubellite is the Jonas Mine in Brazil where a large pocket (2 × 2,5 m) of cranberry-red crystals was discovered in April 1978. A fine example is shown in Figure 6 (from the MR), surrounded aesthetically by light pink lepidolite. Crystals up to 1 m in length were recovered from the main pocket, without the usual covering of clay and mud. According to the MR of March-April 1979, the largest specimen, the so-called Rocket, the largest fine tourmaline crystal known at 109 cm, apparently sold for $30 million and two lesser ones for a mere $10 million for the pair. About 4 t of gem rubellite may have been removed from the mine. This story has a bizarre ending; the lessor, Jonas, blew up the mine after a dispute with the landowner over the lease fee! A much more modest specimen from my collection is shown in Figure 7 and a more typical colour and habit is shown in Figure 8, from the Himalaya Mine, USA.

Left. Figure 6: "Cranberry" tourmaline, Jonas Mine Centre. Figure 7: "Cranberry" tourmaline with lepidolite Right. Figure 8: Elbaite var. rubellite, Himalaya Mine, 5,4 cm

At the Pederneira Mine in Brazil, a series of 28 pockets were discovered between 1999 and 2012 (last date I have information for) as specimen mining continued along the host pegmatite. The tourmalines in each pocket have their own distinctive colour and habit, including bottle green gemmy crystals up to 16 cm in length associated with shocking pink lepidolite, an example of which is shown in Figure 9 (from MR), pink, red, purple, black, green and blue and combinations of these. Pockets were often disturbed by natural geological events and many of the specimens had to be retrofitted onto matrix and the crystals themselves required repairing. The process from finding a pocket to getting a specimen to market after cleaning and expert repairing could apparently take from three months to three years.






Left. Figure 9: Pederneira Mine example, 8,2 cm. Centre left. Figure 10: Rubellite from Otjua Mine, Karibib area. 4, cm
Centre right. Figure 11: Elbaite, bi-coloured, 5,3 cm Right. Figure 12: Blue cap tourmaline, 13,2 cm

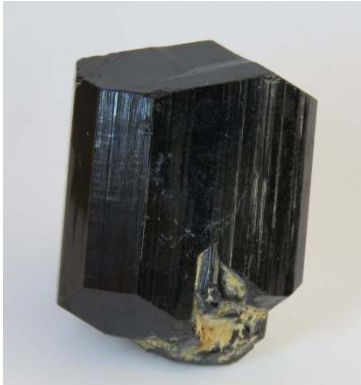
Closer to home, gem and specimen quality elbaite of mainly green and red colours is found in the Karibib and Usakos pegmatites. An example of a red crystal group from the Otjua Mine is shown in Figure 10 (photo of a photo, hence poor quality, my specimen was sold some years ago). Apparently tourmaline is the second-most important mineral economically for Namibia behind diamonds.

Elbaite often changes colour along the C-axis in response to changes in chemistry of the circulating fluids and they often have a green base and mid-section turning to red or pink towards the termination and *vice versa*. An example is shown in Figure 11 from the Himalaya Mine in the USA. The most extreme example of this effect was the so-called blue cap tourmalines discovered at the Tourmaline Queen Mine in the USA in 1972. Some world-class specimens were retrieved including one that probably ranks right up there as a world's best of any species, the aptly named *Rabbit's Ears* specimen, now in the Houston Museum of Natural History. The blue cap is due to an increase in the concentration of iron in the later stages of crystallisation. An example is shown in Figure 12 (from MR).

Elbaite can also show colour zoning giving rise to the so-called 'watermelon' crystals where the core is red and the outer layers green. Crystals up to 2 m in length occur. A unique electric blue variety, known in the trade as Paraiba tourmaline, was discovered fairly recently in Brazil, although similar material has apparently since been found in Nigeria and Madagascar.

Schorl is probably the best-known tourmaline locally, being a common mineral in the Erongo and Spitskoppe areas of Namibia. The name is probably derived from the 16th century German terms *schurl, shurl* or *shirl*, which were used for little black stones that were rejected from tin and gold ore washings. You'll find its black often glossy crystals in just about every local mineral shop/show/club and it's usually relatively cheap. This type contains iron. The most aesthetic specimens probably come from Pakistan, associated with aquamarine, quartz and feldspar (clevelandite usually).

Crystal form varies from compact prismatic crystals, typical of the Namibian specimens (Figure 13), to the more typical tourmaline habit of being elongated along the C-axis, typical of the Pakistan examples (see Figure 14, from the Smale collection). Some very aesthetic specimens of shiny black 'casket' crystals on feldspar have come out of the Erongo region. Crystals up to 1 m in length occur.




Left. Figure 13: Schorl from Namibia Right. Figure 14: Schorl from Pakistan

With **dravite**, we start getting into the less well-known species. Dravite mostly comes in prismatic crystals, similar to schorl in some ways but with a more elongated C-axis. It is usually brown and opaque and is found in metamorphic rocks in e.g. Austria and Australia. Figure 15 shows an example from Australia. It takes its name from its discovery in the Drave district in Corinthia, Austria-Slovenia, in 1881. **Chrome dravite** is a deep green colour and is found in the gem-rich Merelani Hills area of Tanzania. A small example is shown in Figure 16.

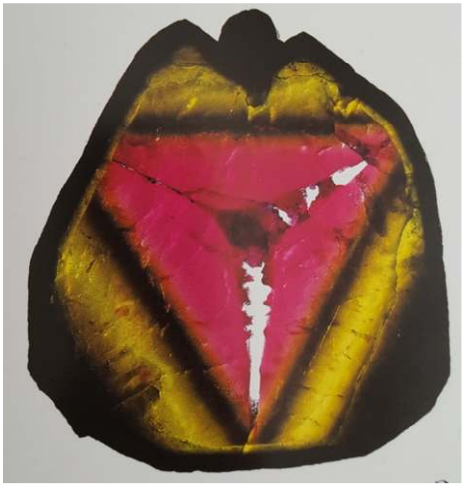

Left. Figure 15: Dravite crystal, 5 cm Right. Figure 16: Chrome dravite, 1,5 cm

Uvite, named for the type location in Uva Province Sri Lanka, forms very attractive crystals of unusual habit for a tourmaline. It usually comes in green, red and brown mostly often associated with magnesite, but also in black in the crystals from Pierrepoint, New York state (crystals up to about 5 cm). The Pomba Pit in Brumado, Brazil is probably the most famous locality and produces superb specimen-grade material of red, green and brown. Examples of the latter two colours are shown in Figures 17 and 18 and illustrate the unusual crystal habit of this locality. It was recognised as a separate species in 1977.


Left. Figure 17: Green uvite, Brazil Right.Figure 18 Brown uvite, Brazil

Liddicoatite, named after a former president of the Gemological Institute of America, Richard Liddicoat, is the common tourmaline found in Madagascar and is characterised by colourful cross sections of outer green and inner red/orange often with a triangular “Mercedes Benz” image in the centre. It is a calcium-lithium type.

An example is shown in Figure 19 (from extraLapis No. 3) and a crystal in Figure 20 (from extraLapis No. 3). It was only recognised as a separate species in 1977.


Left. Figure 19 Liddicoatite cross section, Madagascar **Centre. Figure 20 Liddicoatite crystal, Madagascar**
Right. Figure 21: Buergerite, Mexico

I've only included **buergerite** as a curiosity. I read about it in the article on the famous Mexican collector, Miguel Romero in a supplement to the November–December 2008 issue of The Mineral Record. The location of the original and only known occurrence on a farm in Mexico was 'lost' when the rancher died without revealing the position. Romero commissioned a search and eventually relocated the deposit. The tourmaline is hosted in rhyolite and the crystals are dark brown with an almost tortoiseshell appearance and up to 4 cm in length. A photograph of a photograph in the above supplement of what is widely regarded to be the 'best of' specimen of this type is shown in Figure 21 (from MR supplement 2008). Somewhat ironically, given the very localised nature of its occurrence, this was the fourth tourmaline species to be recognised in 1966.

And there we'll leave it for now without I hope having got too technical and just giving a broad overview of the commoner and not so common species that make up this most attractive of minerals, the Tourmaline Group. I've certainly learnt a lot; thanks Jo.

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SOME ROCKS AND MINERALS OF THE WESTERN CAPE

Duncan Miller

This is the first of a series of articles about the geology of the Western Cape that Duncan has written for the club. An online version of this article is available on the club's website at
http://ctminsoc.org.za/resources/1.%20SOME%20ROCKS%20AND%20MINERALS%20OF%20THE%20WESTERN%20CAPE.pdf

Rocks are collections of mineral grains, sometimes embedded in natural glass. Minerals are simply naturally occurring chemicals, usually compounds made up of various chemical elements. Most rocks can be classified as one of three types, based on how they formed. Igneous rocks solidify from a melt. The coarser varieties, like granite, consist of interlocking mineral grains that grew while solidifying slowly.